

Mean Areas and Heliographic Latitudes of Sun-spots, 1874 to 1888, deduced from Photographs taken at Greenwich, at Dehra Dûn (India), and in Mauritius.
(Communicated by the Astronomer Royal.)

The following tables give the results of the measurements of solar photographs taken at the Royal Observatory, Greenwich, at Dehra Dûn, India, and at the Royal Alfred Observatory, Mauritius, for each synodic rotation of the Sun in 1888, and for each year from the commencement of the Greenwich series. The Indian series of Sun pictures used in these measurements begins on 1881 December 22, and the Mauritius series on 1885 January 3. The daily photographic record is practically complete from the beginning of 1882.

Table I. gives the mean daily areas of umbræ, whole spots, and faculæ for each synodic rotation of the Sun in 1888. The areas are given in two forms : first, projected areas—that is, as seen and measured on the photographs, these being expressed in millionths of the Sun's apparent disk ; and next, areas as corrected for foreshortening, the areas in this case being expressed in millionths of the Sun's visible hemisphere. Table II. gives the mean daily areas (corrected for foreshortening) for each year from the commencement of the Greenwich series, and the projected areas for the years 1882 to 1888, the projected areas for the years preceding 1882 not having yet been computed. Table III. exhibits for each rotation in 1888 the mean daily area of whole spots, and the mean heliographic latitude of the spotted area, for spots north and for spots south of the equator, together with the mean heliographic latitude of the entire spotted area, and the mean distance from the equator of all spots. Table IV. gives the same information for each year from 1874 to 1888.

TABLE I.

No. of Rotation.	Date of Commencement of each Rotation.	No. of days on which Photographs were taken.	Mean of Daily Areas.						
			Projected.	Corrected for Fore-shortening.					
			Umbræ.	Whole Spots.	Faculæ.	Umbræ.	Whole Spots.	Faculæ.	
458	1887 December	26·77	26	33	202	366	24	145	462
459	1888 January	23·11	27	3	14	205	3	15	255
460	February	19·45	26	37	243	219	24	157	262
461	March	17·77	27	5	37	279	5	34	299
462	April	14·06	26	5	29	190	4	26	223
463	May	11·30	28	50	276	203	37	206	226
464	June	7·51	27	7	58	305	5	36	326
465	July	4·71	27	4	30	177	3	25	214
466	July	31·91	27	4	28	130	3	20	158
467	August	28·15	28	31	208	235	23	152	279
468	September	24·42	27	2	19	120	1	8	143
469	October	21·71	27	51	304	120	34	205	135
470	November	18·01	26	36	204	216	24	143	234

May 1889.

Latitudes of Sun-spots.

381

The rotations in the above table are numbered in continuation of Carrington's series (Observations of Solar Spots made at Redhill by R. C. Carrington, F.R.S.), No. 1 being the rotation commencing 1853 November 9. The assumed prime meridian is that which passed through the ascending node at mean noon on 1854 January 1, and the assumed period of the Sun's sidereal rotation is 25.38 days. The dates of the commencement of the rotations are given in Greenwich Civil Time, reckoning from mean midnight.

TABLE II.

Year.	No. of days on which Photographs were taken.	Mean of Daily Areas.					
		Umbræ.	Projected. Whole Spots.	Faculæ.	Corrected for Foreshortening.		
					Umbræ.	Whole Spots.	Faculæ.
1873	58	...	...	...	120	701	3401
1874	159	...	...	...	85	601	813
1875	161	...	...	...	48	272	451
1876	162	...	...	...	25	122	256
1877	168	...	...	...	19	92	175
1878	146	...	...	...	5	24	90
1879	126	...	...	...	11	49	151
1880	158	...	...	...	85	416	977
1881	181	...	...	...	149	730	1733
1882	343	254	1339	2033	189	1002	2154
1883	340	283	1556	1592	175	1155	1856
1884	315	172	1304	1501	148	1079	2057
1885	354	146	1136	1250	101	811	1496
1886	363	71	527	473	50	381	579
1887	361	37	243	256	26	179	301
1888	358	20	126	204	14	89	236

The Means of Daily Areas for the year 1873 refer to a period of about five months commencing 1873 July 28.

Many of the photographs taken during the early part of 1874 do not show the faculæ with sufficient distinctness to allow of their measurement. The mean of daily areas of faculæ for the half-year beginning 1874 June 20 is 1102.

TABLE III.

No. of Rota- tion.	Date of Commencement of each Rotation.	No. of days on which Photo- graphs were taken.	Spots North of the Equator.		Spots South of the Equator.		Mean Heliographic Latitude of entire Spotted Area.	Mean Distance from Equator of all Spots.
			Mean of Daily Areas.	Mean Heliographic Latitude.	Mean of Daily Areas.	Mean Heliographic Latitude.		
458	1887 December	26.77	26	11 + 2.65	134	-8.50	-7.65	8.06
459	1888 January	23.11	27	0 ...	15	-5.10	-5.10	5.10
460	February	19.45	26	66 + 2.99	91	-4.66	-1.46	3.96
461	March	17.77	27	23 + 3.18	11	-8.61	-0.61	4.93
462	April	14.06	26	0 ...	26	-7.48	-7.48	7.48
463	May	11.30	28	0 ...	206	-8.01	-8.01	8.01
464	June	7.51	27	15 + 4.75	22	-6.15	-1.74	5.59
465	July	4.71	27	2 + 5.95	24	-9.80	-8.65	9.52
466	July	31.91	27	4 + 7.48	16	-4.07	-1.99	4.68
467	August	28.15	28	2 + 5.03	150	-7.25	-7.10	7.22
468	September	24.42	27	0 + 1.95	8	-5.62	-5.58	5.60
469	October	21.71	27	141 + 10.20	65	-4.07	+5.71	8.27
470	November	18.01	26	0 ...	143	-9.98	-9.98	9.98

TABLE IV.

Year.	No. of days on which Photographs were taken.	Spots North of the Equator.		Spots South of the Equator.		Mean Heliographic Latitude of entire Spotted Area.	Mean Distance from Equator of all Spots.
		Mean of Daily Areas.	Mean Heliographic Latitude.	Mean of Daily Areas.	Mean Heliographic Latitude.		
1874	132	275	+ 9.01	362	-12.18	-3.03	10.81
1875	161	153	+ 11.16	119	- 9.46	+ 1.99	10.58
1876	162	32	+ 12.58	90	-10.91	-4.66	11.35
1877	168	26	+ 9.12	65	- 9.51	-4.18	9.40
1878	146	24	+ 7.14	1	- 8.09	+ 6.92	7.15
1879	126	14	+ 23.59	35	-22.51	-9.18	22.82
1880	158	257	+ 20.01	159	-19.45	+ 4.90	19.80
1881	181	500	+ 18.17	229	-18.29	+ 6.70	18.21
1882	343	443	+ 15.99	558	-19.26	-3.67	17.81
1883	340	340	+ 10.99	815	-13.90	-6.57	13.04
1884	315	478	+ 10.67	601	-11.74	-1.82	11.27
1885	354	283	+ 10.54	528	-12.41	-4.40	11.76
1886	363	76	+ 9.93	305	-10.50	-6.42	10.38
1887	361	44	+ 8.75	134	- 8.34	-4.09	8.44
1888	358	20	+ 7.10	69	- 7.48	-4.22	7.39

The Means of Daily Areas, &c., in Table IV. for the year 1874, refer to a period of eight months from 1874 April 27, to 1874 December 28.

May 1889.

Latitudes of Sun-spots.

383

The foregoing tables would appear to indicate that the Sun-spot minimum is now close at hand; for the mean daily area of Sun-spots for the year 1888 was slightly smaller than for the year 1877, and the period of complete quiet at the last minimum commenced in November 1878, so that supposing the present decline to follow precisely the precedent of the last, the minimum would take place before the close of the present year. The distribution of the spots in latitude points to a similar conclusion, for the mean distance from the equator of all spots for 1888 is almost as small as for the year 1878. A further indication in the same direction has already been pointed out by the Rev. S. J. Perry (*Nature*, vol. xxxix. p. 223). In previous cycles it has often occurred, as Professor Spoerer has pointed out, that, whilst during the decline to minimum the mean distance from the equator of all spots has steadily decreased, the fact that the minimum has been passed has been signalled by the appearance of a spot in a high latitude. On 1888 December 30, a small faint spot was observed in 36° S. latitude. It was, indeed, a very small and evanescent spot; it had not formed at $5^{\text{h}} 51^{\text{m}}$ Greenwich Civil Time, when the daily photograph of the Sun was taken at Dehra Dûn; but it was fairly conspicuous at $10^{\text{h}} 35^{\text{m}}$ G.C.T., when it was seen and drawn at Stonyhurst College Observatory. It was still visible though very small and faint at $13^{\text{h}} 5^{\text{m}}$ G.C.T., when a photograph was taken at the Royal Observatory, Greenwich, but it had wholly disappeared before the next day.

Table IV. brings out the remarkable predominance as to spotted area which the southern hemisphere has shown over the northern during the last seven years. From 1874 to 1881, sometimes the one hemisphere and sometimes the other appeared the more prolific, but on the whole the spots were very evenly divided between the two. In 1881 the mean spotted area north was more than double the mean area south, but in April 1882 there was a very remarkable outburst in the southern hemisphere which transferred the predominance to that region. In November of the same year the largest single spot of the present cycle appeared in the northern hemisphere, and the balance was again shifted, but after its disappearance the southern hemisphere has been almost invariably the richer of the two; indeed, for the total of the last six years the area south has been very nearly double that of the area north, and whilst many rotations have been entirely barren of spots north of the equator, that has never been the case south. Corresponding to this inferiority in extent of spotted area for the northern hemisphere has been a similar inferiority in mean latitude; the mean latitude of the southern spots being considerably greater than of the northern for each year from 1882 to 1888, with the single exception of 1887.

Royal Observatory, Greenwich:
1889 May 9.

Note on an Error in Le Verrier's "Tables du Soleil."

By R. T. A. Innes.

There is a small error in Le Verrier's Tables of the Sun (*Les Annales*, vol. iv.) which, as far as I am aware, seems to have escaped detection.

In the expression for R on p. 103 the same variation of the excentricity is used as on p. 54, viz. :—

$$-0.000,000,4338$$

instead of

$$-0.000,000,4244$$

resulting from $-0''.08755$ on p. 102.

In calculating R especially for a distant epoch it will be worth while to take this correction into account.

In vol. xl. p. 598 of the *Monthly Notices*, Sir G. B. Airy puts

$$\frac{\text{Variation of E for 1 year}}{E} = -\frac{.0000004338}{.01676927};$$

this should be

$$-\frac{.0000004244}{.01677106}.$$

This changes the value of the lunar acceleration from

$$5''.4773 \text{ to } 5''.3587.$$

The two following tables will enable the correction to be applied during the time covered by Le Verrier's Tables.

Le Verrier's Tables of the Sun. Section V. Table XXXII.

The seventh decimal place taken for unity.

	Mean Anomaly.	Correction to Var. Séc. Natl. No.	Logar n.		Mean Anomaly.
0	360	-9.3 +	-4.0 +	180	180
5	355	-9.3 +	-4.0 +	175	185
10	350	-9.2 +	-4.0 +	170	190
15	345	-9.0 +	-3.9 +	165	195
20	340	-8.7 +	-3.8 +	160	200
25	335	-8.4 +	-3.7 +	155	205
30	330	-8.1 +	-3.5 +	150	210
35	325	-7.6 +	-3.3 +	145	215
40	320	-7.1 +	-3.1 +	140	220
45	315	-6.6 +	-2.9 +	135	225
50	310	-6.0 +	-2.6 +	130	230